



(51) International Patent Classification:

F24D 19/04 (2006.01) *F24H 3/08* (2006.01)
F24D 5/02 (2006.01) *F24H 9/00* (2006.01)

(21) International Application Number:

PCT/GB2017/050701

(22) International Filing Date:

15 March 2017 (15.03.2017)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

1607604.4 29 April 2016 (29.04.2016) GB

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(81) Designated States (*unless otherwise indicated, for every kind of national protection available*): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO,

DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: CONCEALED HEATER

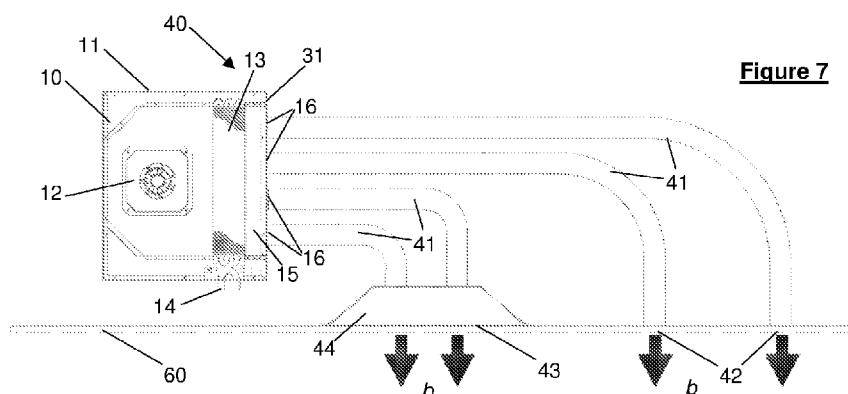


Figure 7

(57) Abstract: A heating unit (10) comprises a housing (11), at least one heat exchanger coil (13), an electrically driven fan (12), and at least one spigot connector set (15). The heat exchanger coil (13) is disposed within the housing (11), and is in communication with a domestic hot water and/or heating system. The electrically driven fan (12) is also disposed within the housing, and is arranged to drive or draw air over the heat exchanger coil (13), thereby to heat said air. The spigot connector set (15), comprises one or more spigot connectors (16), formed in the housing (11) adjacent the heat exchanger coil (13). The spigot connectors (16) are adapted to transfer heated air from the heat exchanger coil (13), via at least one duct (41), to an outlet set comprising one or more outlets (43).



Concealed Heater

This invention relates to a heating unit suitable for use as a plinth heater, and to a heating installation comprising such a heating unit installed in a building structure or article of furniture, such as a kitchen unit, to serve as a plinth heater. In particular,
5 it relates to such a heating installation adapted so that the heating unit is substantially hidden from view.

The term “plinth” as used herein refers to the lowermost front-facing panel of a building structure or article of furniture, such as a floor-mounted kitchen unit.

It is common to install plinth heaters at the bottom of kitchen units, to provide
10 space heating for kitchens. Such heaters have the advantage of providing space heating without requiring wall space such as would be required by radiators. This is an important consideration in kitchens, where there is likely to be minimal available wall space due to the presence of fitted kitchen units. Plinth heaters further save space by being housed in the otherwise redundant space under kitchen units. Typical
15 plinth heating units may either have an electric heating element, or may comprise a hydronic or ‘wet’ heat exchanger in communication with a domestic hot water heating system.

Despite their utility, plinth heaters are regarded as being unsightly, due to the front grille outlet portion of the heater being mounted directly in the plinth of the
20 kitchen unit. This necessitates forming a large hole in the plinth in which to mount the grille outlet, which is considered to spoil the overall look of the kitchen unit.

As an alternative space saving option for heating kitchens, the use of underfloor heating has become popular. However, this is costly and inconvenient to install. Additionally, underfloor heating does not benefit from the same degree of
25 controllability as a plinth heater.

The present invention seeks to address the above issues by providing an improved and unique plinth heater system which retains the low installation cost benefits of a conventional plinth heater, whilst enabling the outlets to be more aesthetically pleasing by enabling their size to be reduced, and also enabling them to
30 be positioned in discrete and/or concealed locations. The invention also seeks to provide flexibility in the selection of locations for such outlets. Adaptations to the components of the heating unit also serve to enhance its efficiency compared to conventional plinth heaters.

The present invention has been developed in particular for installation in kitchen units and is therefore described herein with particular reference to that application. However, it should be understood that the invention may also be installed in other building structures or articles of furniture, and in other domestic, commercial and industrial settings, and such applications are within the scope of the present invention.

Therefore, according to a first aspect of the present invention there is provided a heating unit comprising:

- a housing;
- at least one heat exchanger coil disposed within said housing, in communication with a domestic hot water and/or heating system;
- an electrically driven fan disposed within said housing and arranged to drive or draw air over said heat exchanger coil, thereby to heat said air; and
- at least one spigot connector set, comprising one or more spigot connectors, formed in said housing adjacent said heat exchanger coil and adapted to transfer heated air from said heat exchanger coil, via a duct, to an outlet set comprising one or more outlets.

In a first major embodiment of the first aspect of the present invention as described above, the heating unit comprises a single heat exchanger coil.

In a second major embodiment of the first aspect of the present invention:

- the unit comprises first and second opposed heat exchange coils, each in communication with a domestic hot water and/or heating system;
- the fan is located between said opposed first and second opposed heat exchanger coils and is arranged to drive or draw air over said heat exchanger coils;
- the unit comprises first and second spigot connector sets, said first spigot connector set being formed in the housing adjacent the first heat exchanger coil and adapted to transfer heated air from said first heat exchanger coil to a first outlet set, and said second spigot connector set being formed in the housing adjacent the second heat exchanger coil and adapted to transfer heated air from said second heat exchanger coil to a second outlet set.

The electrically driven fan is preferably a backwards curved fan. The fan may preferably be either an electrically commutated (EC) or alternating current (AC) fan, and preferably has a diameter in the range of from 133 to 190 mm. The use of a backwards curved fan of this kind, in place of the more conventional tangential fan

often used in plinth heaters, enables the generation of sufficient air pressure to drive air over the heat exchanger coil(s) and out through the relatively narrow spigot connector(s), duct(s) and outlet(s).

5 The fan housing should preferably be adapted to accommodate modular controls. The fan is preferably further provided with a low temperature cut-out (LTC) control adapted to operate at a temperature in the range of from 35 to 38 °C.

An air inlet is preferably formed in the housing of the heating unit. Most preferably, the air inlet is aligned with the air intake of the electrically driven fan.

10 The or each spigot connector set may preferably each comprise two, three or more spigot connectors. Each said spigot connector is adapted to transfer heated air from the adjacent heat exchanger coil, via a duct, to an outlet. The spigot connectors preferably have a diameter of around 50mm. In embodiments having first and second spigot connector sets, these are preferably located on opposed sides of the housing.

15 The housing preferably has a height of around 100mm, in order that unit can fit in standard plinth spaces having heights of 120mm or 150mm. The housing may have a preferred depth of around 250mm.

The heating unit preferably has a maximum power output of around 3kW and a maximum heat output of around 10,000 BTU.

20 As noted above, the heating unit according to the first aspect of the present invention is intended for installation in combination with one or more ducts arranged to transfer heated air from the unit to one or more outlets located remotely from the unit.

25 Therefore, according to a second aspect of the present invention there is provided a heating installation comprising:

- a heating unit as hereinbefore described;
 - at least one outlet set, comprising one or more outlets, in communication with a spigot connector set of said heating unit;
 - at least one duct set, comprising one or more ducts, connected to said
- 30 spigot connector set and arranged to transfer heated air to said outlet set.

In a first major embodiment of the second aspect of the present invention as described above, the heating unit comprises a single heat exchanger coil.

In a second major embodiment of the second aspect of the present invention:

- the heating unit is as hereinbefore described with reference to the second major embodiment of the first aspect of the present invention;

- the installation comprises first and second outlet sets, said first outlet set being
5 in communication with the first spigot connector set of the heating unit, and said second outlet set being in communication with the second spigot connector set of the heating unit; and

- the installation comprises first and second duct sets, said first duct set being connected to the first spigot connector set and arranged to transfer heated air to the
10 first outlet set, and said second duct set being connected to the second spigot connector set and arranged to transfer heated air to the second outlet set.

The or each outlet set may preferably comprise two, three or more outlets, so as to correspond to the number of spigot connectors in the or each spigot connector set. Similarly, the or each duct set may preferably comprise two, three or more ducts,
15 in order to correspond to the number of spigot connectors in the or each spigot connector sets, and the number of outlets in the or each outlet set.

Each duct preferably has a diameter of around 50mm, in order to match that of the spigot connectors. The heating unit is preferably supplied with ducting having a maximum length of around 10m. This may be cut to the required length and divided
20 as required between the ducts utilised in the installation.

At least one, and preferably each, said outlet is mounted at a location remote from the housing of said heating unit. At least one, and more preferably each, said outlet may be mounted on a surface of a building structure or an article of furniture, said heating unit being housed within an internal space of said building structure or
25 article of furniture.

In a preferred embodiment of heating installation according to the second aspect of the present invention, at least one, and preferably each, said outlet is mounted on a surface of a kitchen unit, said heating unit being housed within an internal space of said kitchen unit. Said at least one outlet may desirably be mounted
30 in, on, or closely adjacent a plinth of said kitchen unit. Alternatively, or additionally, at least one said outlet may desirably be mounted on a surface of a kitchen unit other than a plinth of said unit.

The provision of multiple spigot connectors, ducts and outlets allows for a great deal of flexibility in the location of the outlets. For example, in a single installation, outlets may be provided at a plurality of different locations including the plinth of a kitchen unit, other surfaces of the kitchen unit, or the surfaces of adjacent units, building structures or articles of furniture.

At least one, and preferably each, said outlet is mounted in a discrete position so as to enhance the aesthetic qualities of the installation. Each outlet preferably comprises an outlet grille, of a size and shape adapted such that said outlet grille is not normally visible when mounted in said discrete position. For example, the desired effect of having the outlet located on a plinth of a kitchen unit, but yet being at a discrete, and not normally visible position, could be achieved by providing a narrow, elongated outlet grille along the top edge of a plinth, where its position would normally be concealed by over-hanging doors of the kitchen unit. Other suitable alternative forms of outlet grille include circular outlets, preferably having a diameter of around 70mm, or rectangular outlets similar to demister vents used in cars.

A further advantage of the present invention over conventional plinth heaters is that the arrangement described herein results in reduced noise when the heating unit is operating. This is because the heating unit of the present invention may be located at the back of a kitchen unit, and transfers heated air via ducts to small outlets located remotely from the heating unit. This allows for reduced sound transfer compared to conventional plinth heaters which, by contrast, must be mounted at the front of a unit and transfer heated air out directly via a large aperture in the plinth.

As noted above, whilst the present invention has been developed in particular for installation in kitchen units, it is envisaged that it may also be utilised in other settings. In particular, the heating installation of the present invention is suitable for installation in loft spaces, suspended ceilings and for wall-mounting.

In order that the present invention may be more clearly understood, a preferred embodiment thereof will now be described in detail, though only by way of example, with reference to the accompanying drawings in which:

Figure 1 shows a cross-sectional plan view of a heating unit according to a first major embodiment of the first aspect of the present invention;

Figure 2 shows a cross-sectional front view of the heating unit of Figure 1;

Figure 3 shows a cross-sectional side view of the heating unit of Figures 1 and 2;

Figure 4 shows a cross-sectional plan view of a heating unit according to a second major embodiment of the first aspect of the present invention;

Figure 5 shows a cross-sectional side view of the heating unit of Figure 4;

Figure 6 shows a cross-sectional front view of the heating unit of Figures 4 and 5;

Figure 7 shows a cross-sectional plan view of a heating installation according to a first major embodiment of the second aspect of the present invention;

Figure 8 shows a cross-sectional front view of the heating installation of Figure 7;

Figure 9 shows a cross-sectional plan view of a heating installation according to a second major embodiment of the second aspect of the present invention;

Figure 10 shows a cross-sectional front view of the heating installation of Figure 9;

Figure 11 shows a plan view of an alternative arrangement of heating installation according to the second major embodiment of the second aspect of the present invention; and

Figure 12 shows a front view of the alternative arrangement of heating installation of Figure 11.

Referring first to Figure 1, 2 and 3, there is shown a single coil heating unit, generally indicated 10, according to a first major embodiment of the first aspect of the present invention. The unit 10 comprises a housing 11, having a front panel 31, first and second side panels 32, 33, a rear panel 34, a bottom panel 35 and a top panel 36. The unit 10 is shown in Figure 1 with the top panel 36 removed. Within the housing 11 is disposed a backwards curved fan 12 arranged to drive air onto a first heat exchanger coil 13. The coil 13 is located adjacent the front panel 31, and has connectors 14, provided in side panel 32, for connection to a domestic hot water and/or central heating system (not shown).

As can best be seen in Figure 3, the front panel 31 of the housing 11 features a first set 15 comprising several spigot connectors 16. The spigot connector set 15 is located in the front panel 31, adjacent the heat exchanger coil 13. As can also

be seen in Figure 3 the top panel 36 includes an air inlet 37 for the fan 12. As will be described in more detail below with reference to Figures 7 and 8, each spigot connector 16 is adapted for connection, via a duct, to an outlet.

Referring now to Figure 4, 5, and 6, there is shown a double coil heating unit, generally indicated 20, according to a second major embodiment of the first aspect of the present invention. The double coil heating unit 20 is similar in many respects to the single coil unit 10 described above with reference to Figure 1 to 3, and like reference numerals are used where appropriate to denote like components.

The heating unit 20 differs from the unit 10 of the first major embodiment in that it further comprises a second heat exchanger coil 23, in addition to the first heat exchanger coil 13. The position of the first heat exchanger coil 13 is also changed in that it is now located adjacent the first side panel 32, rather than the front panel 31. The second heat exchanger coil 23 is located adjacent the second side panel 33, such that said first and second heat exchanger coils 13, 23 are arranged opposed and parallel to one another, with the fan 12 located therebetween.

The heating unit 20 also further features a second spigot connector set 25, in addition to the first spigot connector set 15, both sets 15, 25 comprising several spigot connectors 16. The first spigot connector set 15 is located in the first side panel 32, adjacent the first heat exchanger coil 13, whilst the second spigot connector set 25 is located in the second side panel 33, adjacent the second heat exchanger coil 23.

The connectors 14 for connecting both the first and second heat exchanger coils 13, 23 to a domestic hot water and/or central heating system (not shown) are located in the front panel 31 of the unit 20.

Referring now to Figures 7 and 8, there is shown a single coil heating installation, generally indicated 40, according to a first major embodiment of a second aspect of the present invention.

The installation 40 utilises the single coil heating unit 10 described above with reference to Figures 1 to 3. A duct 41 is connected to each spigot 16 in the spigot connector set 15 housed in the front panel 31 of the unit 10. The other end of the ducts 41 are connected to outlets 42, 43, mounted in a plinth 60 of a kitchen unit (not shown). As can be seen in Figure 8, two different types of outlet are employed in the example illustrated: round outlets 42, each fed by a single duct 41, and an elongated rectangular outlet 43, fed by a pair of ducts 41, via a funnel duct 44.

In use, the fan 12 draws ambient air in through the air inlet 37, as indicated by arrows *a* in Figure 8. The air is then blown over the heat exchanger coil 13, whereby it is warmed before exiting the unit 10 through the spigot connectors 16. The warmed air is then channelled through the ducts 41, and out into the room through the outlets 42, 43.

The location of the outlets 42, 43 may be selected so as to minimise the visual impact of the heating installation 40. For example, the round outlets 42 may be located on an end, side or top surface of a kitchen unit (not shown) where they would not normally be visible by a person in the room. The elongate rectangular outlet 43 may be located adjacent the upper edge of the plinth 60, as illustrated in Figure 8, where its location may be concealed by an overhanging cupboard door.

Referring now to Figures 9 and 10, there is shown a double coil heating installation, generally indicated 50, according to a second major embodiment of a second aspect of the present invention. The double coil heating installation 50 is similar in many respects to the single coil heating installation 40 described above with reference to Figures 7 and 8, and like reference numerals are used where appropriate to denote like components.

The double coil installation 50 differs from the single coil installation 40 in that it utilises the double coil heating unit 20 described above with reference to Figures 4 to 6, in place of the single coil heating unit 10. Accordingly, a duct 41 is now connected to each spigot 16 in both the first spigot connector set 13 housed in the first side panel 32 of the unit 20, and the second spigot connector set 23 housed in the second side panel 33 of the unit 20.

During operation of the unit 20, the fan 12 draws ambient air in through the air inlet 37 and blows it over both the first heat exchanger coil 13 located adjacent the first side panel 32, and the second, opposed, heat exchanger coil 23 located adjacent the second side panel 33. The warmed air then exits the unit 20 through the spigots 16 of both the first spigot connector set 15, and the second, opposed, spigot connector set 25. The operation of the heating unit 20 and the heating installation 50, and the positioning of the outlets 42, 43, is otherwise as described above with reference to Figures 7 and 8.

Referring now to Figures 11 and 12, there is shown an alternative arrangement of double coil heating installation, generally indicated 70, also according to the second

major embodiment of the second aspect of the present invention. The alternative double coil heating installation 70 is similar in many respects to the double coil heating installation 50 described above with reference to Figures 9 and 10, and like reference numerals are used where appropriate to denote like components.

5 The alternative double coil installation 70 differs from the double coil installation 50 in that it utilises an alternative double coil heating unit 80, in place of the double coil heating unit 20 described above with reference to Figures 4 to 6. The alternative double coil heating unit 80 differs from the double coil heating unit 20 in that the first and second spigot connector sets 15, 25 each only comprises two spigot connectors
10 16 rather than three. This enables the alternative unit 80 to be more compact, and so allows the unit 80 to be installed in a wider range of potential locations. The fan 12 can thus be a lower powered EC fan. It is envisaged that the alternative unit 80 may be provided in combination with remote control means (not shown) enabling variation of the fan speed. Such remote control means may take the form, for example, of a
15 dimmer switch type control to enable gradual adjustment of the fan speed on a continuous, rather than discrete, scale. A room thermostat (not shown), which may be a wireless room thermostat, may also be used to control the operation of the fan 12. The operation of the heating unit 80 and the heating installation 70, and the positioning of the outlets 43 is otherwise as described above with reference to Figures 7 to 10.

Claims

1. A heating unit comprising:
 - a housing;
 - at least one heat exchanger coil disposed within said housing, in
5 communication with a domestic hot water and/or heating system;
 - an electrically driven fan disposed within said housing and arranged to drive or draw air over said heat exchanger coil, thereby to heat said air; and
 - at least one spigot connector set, comprising one or more spigot
connectors, formed in said housing adjacent said heat exchanger coil and adapted
10 to transfer heated air from said heat exchanger coil, via at least one duct, to an outlet set comprising one or more outlets.
2. A heating unit as claimed in claim 1, wherein:
 - the unit comprises first and second opposed heat exchange coils, each in
communication with a domestic hot water and/or heating system;
 - 15 - the fan is located between said opposed first and second opposed heat
exchanger coils and is arranged to drive or draw air over said heat exchanger coils;
 - the unit comprises first and second spigot connector sets, said first spigot
connector set being formed in the housing adjacent the first heat exchanger coil and
adapted to transfer heated air from said first heat exchanger coil to a first outlet set,
20 and said second spigot connect set being formed in the housing adjacent the second
heat exchanger coil and adapted to transfer heated air from said second heat
exchanger coil to a second outlet set.
3. A heating unit as claimed in claim 1 or claim 2, wherein said electrically driven
fan is a backwards curved fan.
- 25 4. A heating unit as claimed in any of the preceding claims, further comprising
an air inlet formed in said housing.
5. A heating unit as claimed in any of the preceding claims, wherein the or each
spigot connector set comprises two or more spigot connectors.
6. A heating installation comprising:
 - 30 - a heating unit as claimed in any of the preceding claims;
 - at least one outlet set, comprising one or more outlets, in communication with
a spigot connector set of said heating unit; and

- at least one duct set, comprising one or more ducts, connected to said spigot connector set and arranged to transfer heated air to said outlet set.

7. A heating installation as claimed in claim 6, wherein:

5 - the heating unit is as claimed in claim 2, or any of claims 3 to 5 when dependent upon claim 2;

 - the installation comprises first and second outlet sets, said first outlet set being in communication with the first spigot connector set of the heating unit, and said second outlet set being in communication with the second spigot connector set of the heating unit; and

10 - the installation comprises first and second duct sets, said first duct set being connected to the first spigot connector set and arranged to transfer heated air to the first outlet set, and said second duct set being connected to the second spigot connector set and arranged to transfer heated air to the second outlet set.

8. A heating installation as claimed in claim 6 or claim 7, wherein the or each outlet
15 set comprises two or more outlets, and wherein the or each duct set comprises two or more ducts.

9. A heating installation as claimed in any of claims 6 to 8, wherein at least one said outlet is mounted at a location remote from the housing of said heating unit.

10. A heating installation as claimed in claim 9, wherein at least one said outlet
20 is mounted on a surface of a building structure or an article of furniture, said heating unit being housed within an internal space of said building structure or article of furniture.

11. A heating installation as claimed in claim 9, wherein at least one said outlet is mounted on a surface of a kitchen unit, said heating unit being housed within an
25 internal space of said kitchen unit.

12. A heating installation as claimed in claim 11, wherein at least one said outlet is mounted in a plinth of said kitchen unit.

13. A heating installation as claimed in claim 11 or claim 12, wherein at least one said outlet is mounted on a surface of a kitchen unit other than a plinth of said unit.

30 14. A heating installation as claimed in any of claims 9 to 13, wherein at least one said outlet is mounted in a discrete position not normally visible.

15. A heating installation as claimed in claim 14, wherein each said outlet comprises an outlet grille, and wherein each said outlet grille is of a size and shape adapted such that said outlet grille is not normally visible when mounted in said discrete position.

Figure 1

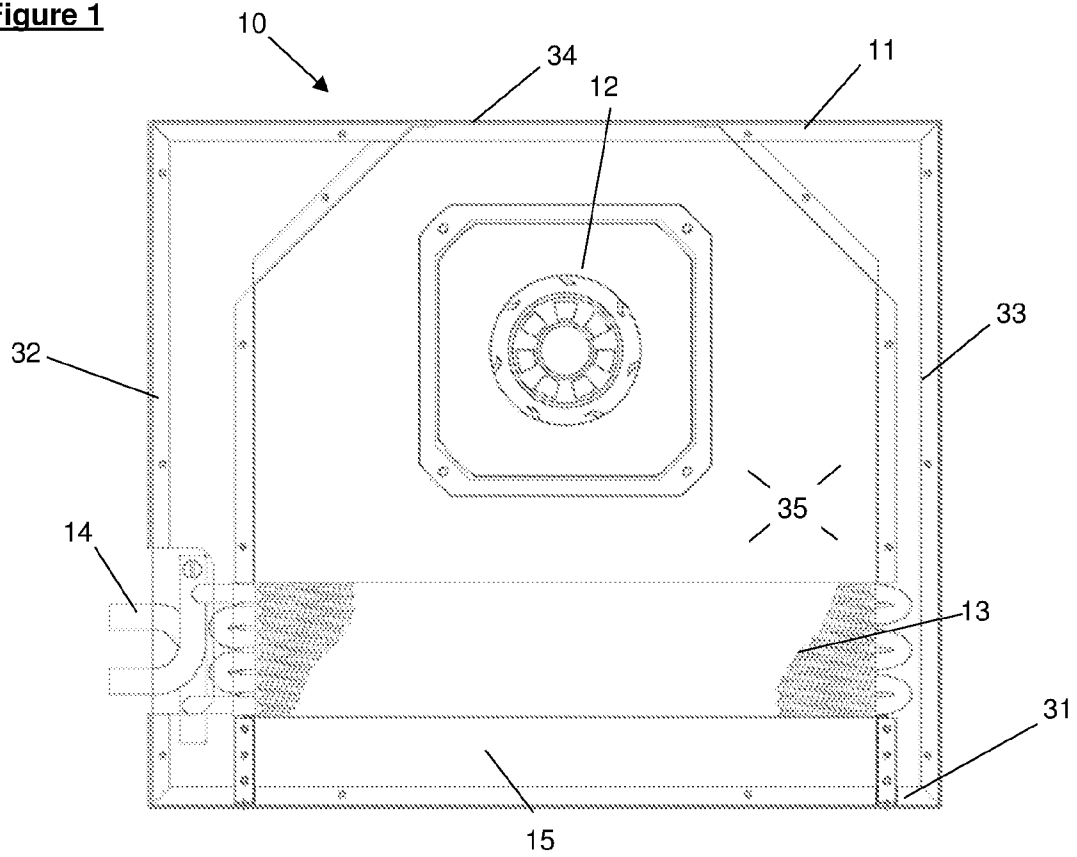


Figure 2

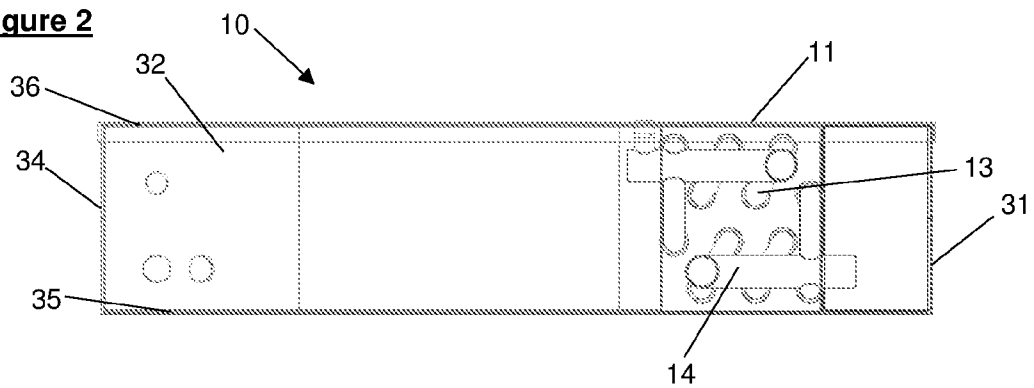


Figure 3

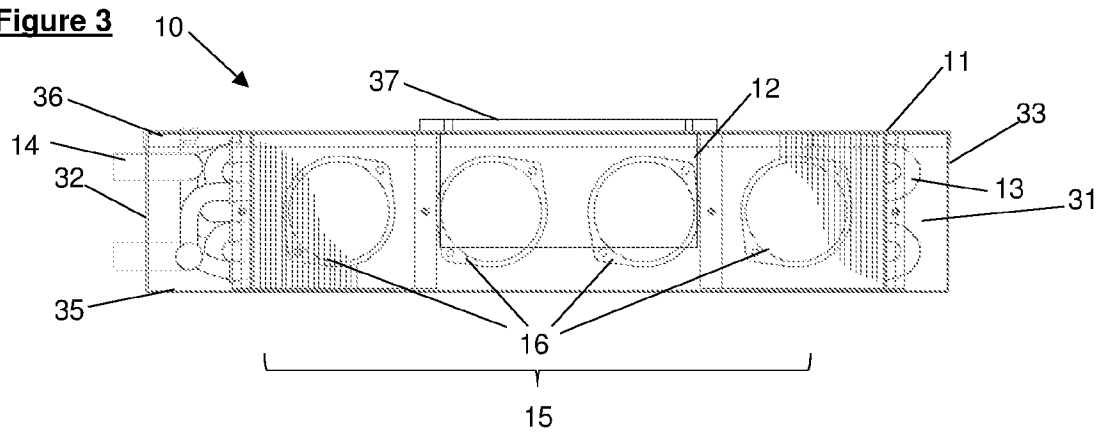


Figure 4

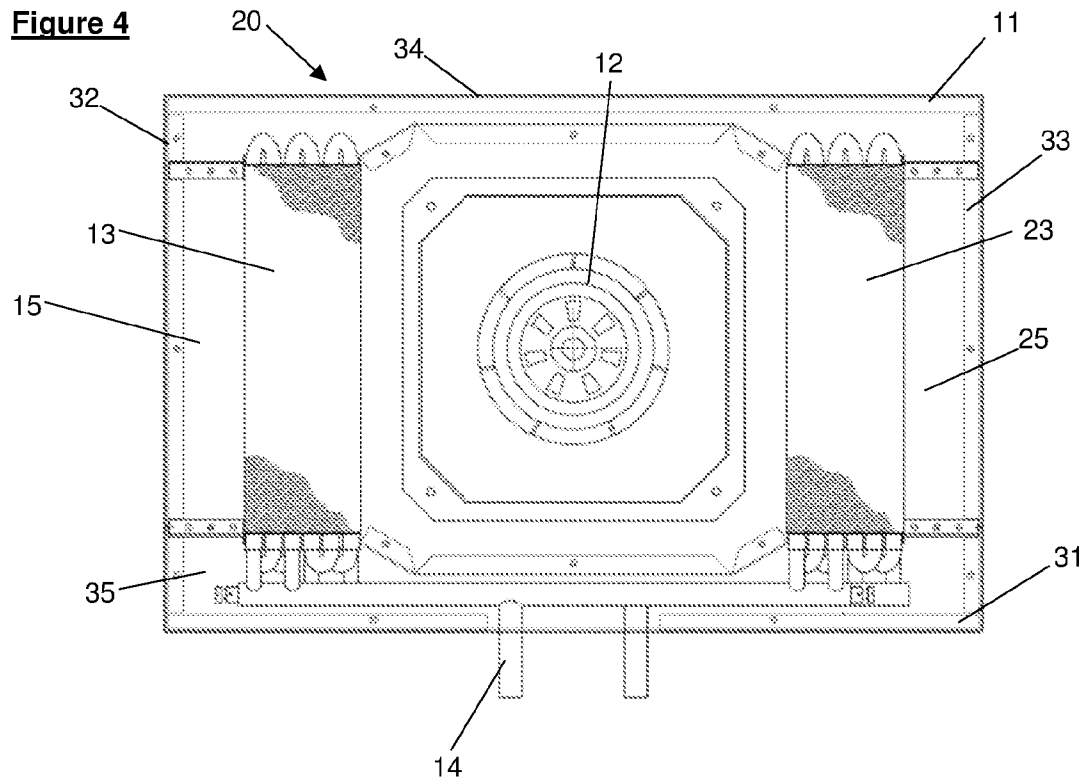


Figure 5

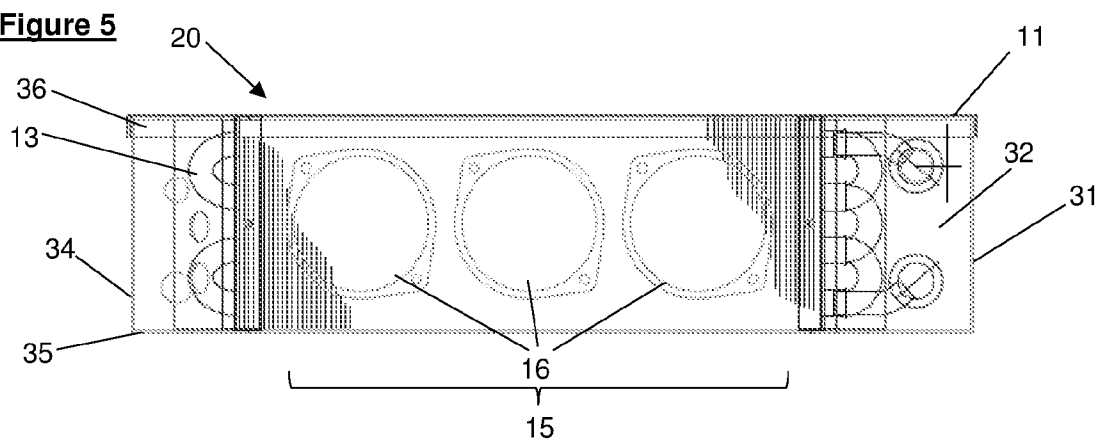
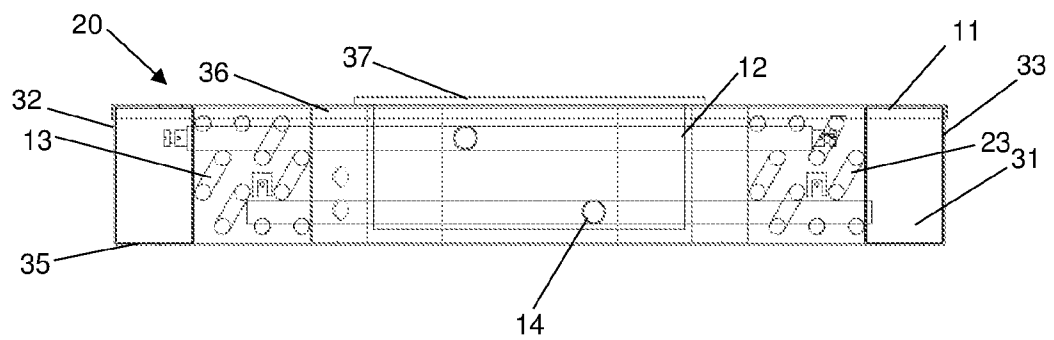


Figure 6



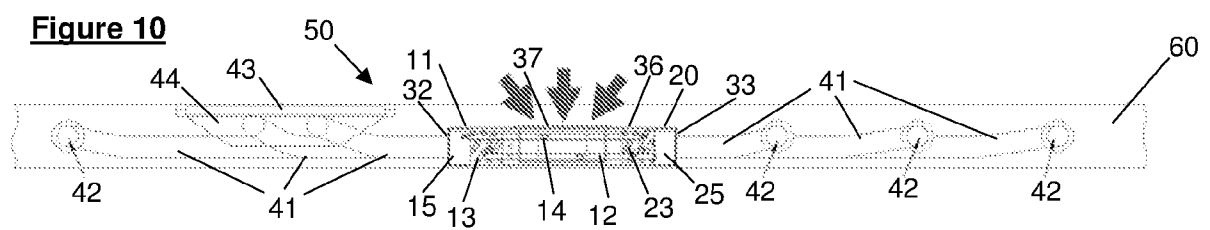
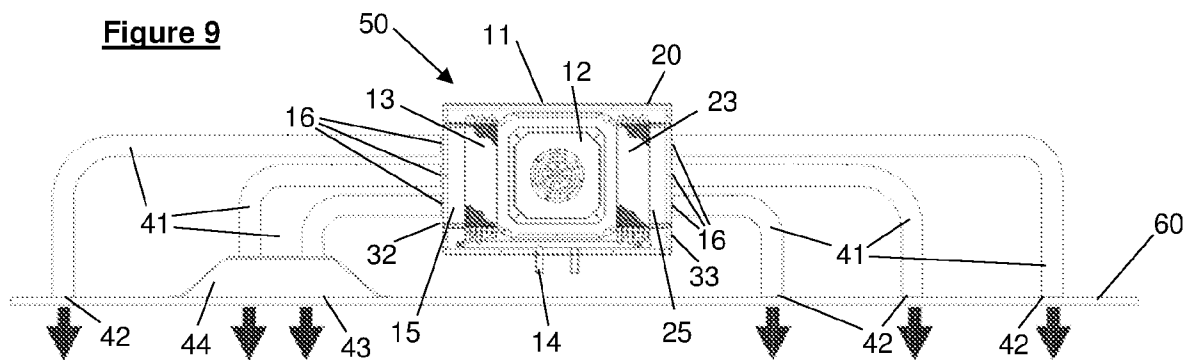
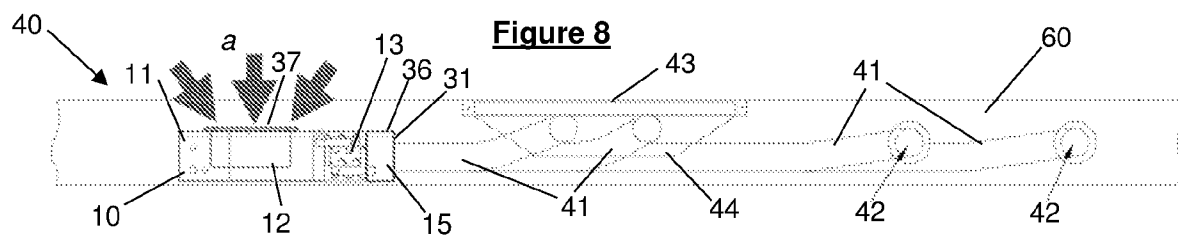
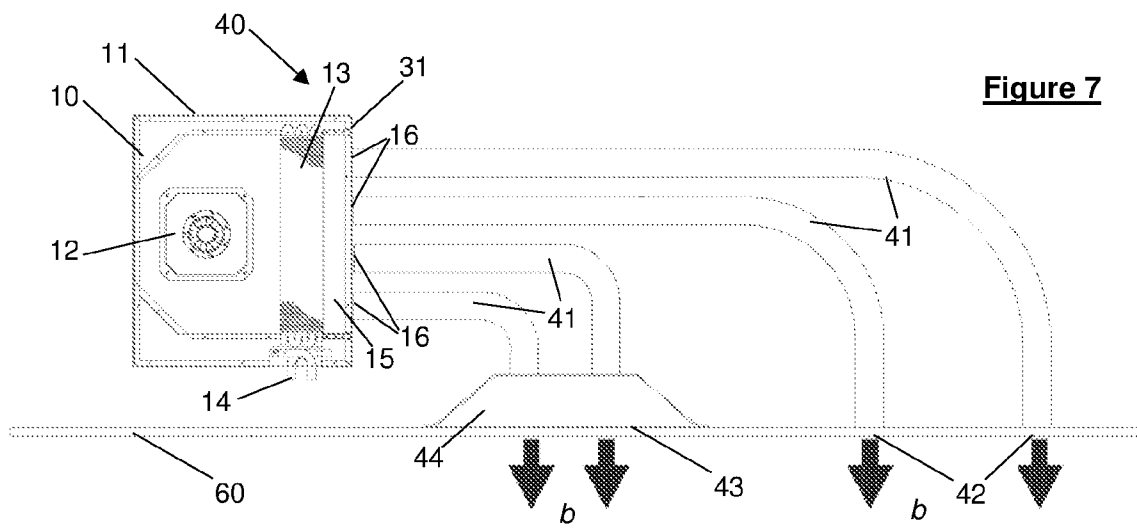


Figure 11

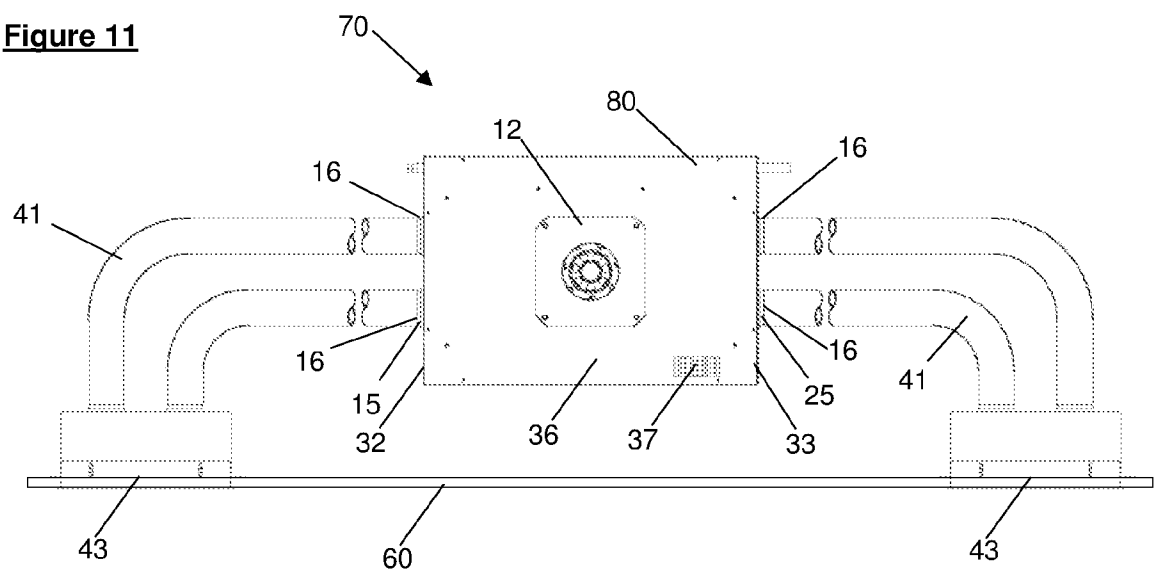
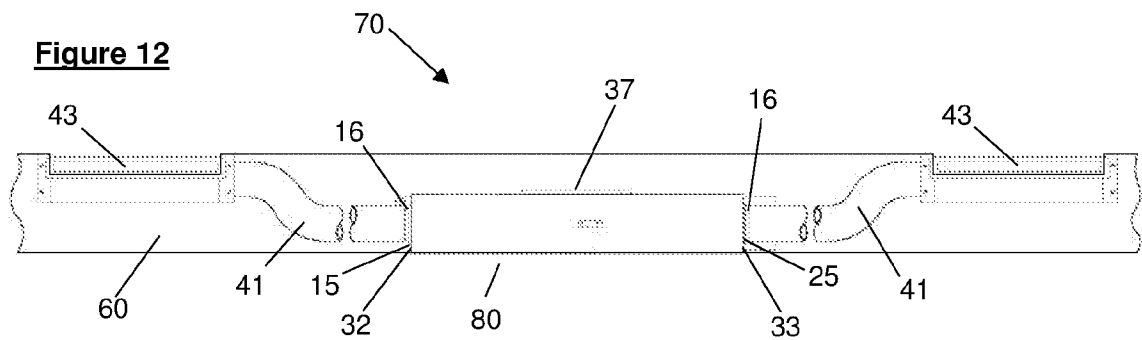


Figure 12



INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2017/050701

A. CLASSIFICATION OF SUBJECT MATTER INV. F24D19/04 F24D5/02 F24H3/08 F24H9/00 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) F24D F24H		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 371 111 A (PERNOSKY RICHARD J [US]) 1 February 1983 (1983-02-01) column 3, line 40 - column 8, line 25; figure 1 -----	1,4-6, 8-10
X	GB 2 475 693 A (SMITH S ENVIRONMENTAL PRODUCTS LTD [GB]) 1 June 2011 (2011-06-01) page 7, line 21 - page 11, line 14; figures 1-3 -----	1,3-6, 8-10
X	EP 1 004 830 A2 (SMITHS INDUSTRIES PLC [GB]) 31 May 2000 (2000-05-31) column 1, paragraph 2 - column 5, paragraph 12; figure 1 ----- -/--	1,4,5, 8-10
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Date of the actual completion of the international search 17 July 2017		Date of mailing of the international search report 25/07/2017
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Hoffmann, Stéphanie

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International application No
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